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PRINCIPLES OF INSECT CONTROL

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The recent publication, "The Principles of Insect Control" by Wardle and Buckle calls attention to the possible advantage of an outline which the writer has been using for the past two years at Purdue University.

The publication referred to above is an excellent contribution since it compiles information on the subject which heretofore has been scattered and not readily available to many students. However, there appears to be a lack of organization and proper arrangement and incomplete analysis of published data for the best results and evidently the authors were unfamiliar with much of the work published by American authors. There is an especial lack of information on the utilization of farm practices, which we must recognize as of greatest importance in the control of crop insect pests and animal ectoparasites and of increasing importance in years to come.

Assuming that the student has secured the fundamentals of classification, structure, and development of insects, which are essential to a proper understanding of insect controls, we can proceed to introduce the general subject of insect control with the three essential steps,—1, Diagnosis; 2, Prescription; and 3, Application. The basis of all insect controls,—our knowledge of the structure, and bionomics—must also be clearly understood before proceeding with a comprehensive study of control principles.

The outline which we are now using and which appears to be a logical arrangement and organization follows :

A. NATURAL CONTROLS. Usually beyond our command for artificial use.

1. CLIMATIC

a. Winter conditions. Relation of stage of hibernation, winter protection, and the varying winter conditions or winter mortality. *Ex.* Chinch bug winter protection; scale exposure.

b. Humidity. Relation to insect development and to the effectiveness of insect diseases. *Ex.* Chinch bug white mold fungus.

c. Soil moisture. Some insects thrive in damp soil, others find such conditions disadvantageous. *Ex.* Most wireworms prefer low, poorly drained soil; white grubs usually find such conditions unsatisfactory.

d. Precipitation. Effects emergence of such insects as Hessian fly. Driving rains in cultivated fields act as a mechanical destroyer of chinch bugs.

e. Wind. Very important in promoting spread of insects.

f. Seasonal weather. Long seasons may permit development of extra generations. *Ex.* Corn ear worm thus became a serious pest of field corn in Indiana in 1921 following the early spring, tropical summer conditions and late fall which permitted the development of extra generations; spring grain aphid abundance following unfavorable weather con-

ditions for the parasites which usually hold it in check.

2. NATURAL ENEMIES

a. Parasites of harmful insects.

b. Predaceous insects attacking harmful kinds.

c. Predaceous birds, mammals, fish and other vertebrates.

d. Fungus and bacterial diseases and the lower animal parasites.

B. ARTIFICIAL CONTROLS

1. FARM PRACTICES. It will be noted that almost all farm practices for insect control are good practices, regardless of the insect question.

a. Cultivation. Develops conditions unfavorable for insect life; also promotes plant growth and produces conditions which enable plants to better overcome insect attacks; exposes insects to predaceous animals. *Ex.* Corn root aphis, timely cultivation destroying the nests of ants, which are important accessories, and preventing growth of weeds upon which the aphids must live previous to corn planting.

b. Plowing. Develops conditions unfavorable for insect life and otherwise acts as does cultivation; in addition there is another important factor, namely the mechanical destruction of insects in the soil. *Ex.* Destruction of plum curculio when it is changing from larva to pupa and adult. Burying stubble by plowing prevents emergence of Hessian fly and jointworm.

c. Good seed, good fertility and good planting conditions. Healthy, vigorous plants can overcome insect injuries to best advantage. Applies to good animal husbandry practices in relation to animal ectoparasites. *Ex.* Shot-hole borer is not a pest of stone fruits when the trees are growing vigorously. Healthy cattle are less subject to lousiness.

d. Rotation of crops. Continuous growing of the same or related crops offers abundant supply of the host. Rotation, and especially a rotation with unrelated crops minimize this favorable condition. *Ex.* Avoiding corn on the same ground year after year largely prevents damage by corn root aphis and the corn root worm.

e. Time of planting. Timeliness of planting to avoid a particular insect. *Ex.* Fall infestation by Hessian fly can usually be avoided by sowing wheat after the so-called fly-free date, i.e., after the fly issues and dies. Early plantings of corn are less subject to corn ear worm. Late planting of corn may avoid injury by cutworms.

f. Time of harvesting. Ex. Angoumois grain moth injury can be avoided to a large extent by prompt harvesting and threshing, and proper storage.

g. Resistant varieties. Some plants more resistant to insect attack than others. (Plants native to the native home of the insect are generally more resistant to the particular insect.) *Ex.* Northern Spy apple resistant to woolly aphis; Grimes and Ben Davis more susceptible to San Jose scale than many other varieties of apple; American grape stock more resistant to Phylloxera than French stock; the Holstein breed of cattle are more susceptible to lice than are Jerseys.

h. Clean culture, or sanitation in the garden, the orchard, the field, as well as in the poultry house and animal barns and lots. *Ex.* Removal of crop residues as in the case of squash vine borer. Volunteer wheat to remove the extra hazard of Hessian fly and especially where the practice of sowing the regular crop of wheat at the right time is universal. Clean culture promotes healthy and vigorous plants and animals.

i. Drainage. To remove conditions which are favorable for some insects. *Ex.* Low ground infesting wireworms.

j. Kind of Cropping. To secure conditions unfavorable to the development of certain insects, to permit handling crops in a specific manner for the control of a certain insect, and to reduce the average of certain susceptible crops. *Ex.* Soybeans in corn furnish conditions unfavorable to chinch bugs; rotations and cropping which offers a minimum of hosts and permits proper disposal of crop residues, as recommended in European corn borer areas; and planting a minimum acreage of corn in areas where chinch bugs are prevalent and corn is not the money crop.

k. Trap crops. Early planting of trap plants or planting of especially attractive plants between rows or near the principal planting to be protected, the object to attract the particular insect pests to other plants than the regular crop. The trap crop must usually be promptly destroyed at a particular time to destroy the insects and not permit their complete development and spread.

2. MECHANICAL METHODS AND DEVICES. Any mechanical method or device for insect control, excepting such methods as may be recognized as farm practices and devices, such as sprayers and dusters used in applying insecticides.

a. Methods. Handpicking of potato beetles and grubs and jarring to collect curculio adults are commonly recognized methods although now largely displaced by more efficient means.

b. Protectors. The house screen, used to secure protection indoors from flies and mosquitoes, is the best known insect protector. Plants may be covered with screen covers as a protection from the striped cucumber beetle. A paper collar is commonly used around the stem of tomato plants as a protection against cutworms. Insect-proof packages are used for protecting dried fruits, cereals, and clothes from insect infestation.

c. Mechanical traps. The grasshopper catcher and hopperdozer are examples of efficient mechanical devices for collecting insects.

3. INSECTICIDES. Any material used to destroy insects or to prevent insect injury. They may be applied as a liquid spray or as a dust, and in the case of stomach poisons they are sometimes mixed with attractive foods and used as poison baits.

a. Stomach poisons. Commonly used for the control of insects with mandibulate mouth parts. *Ex.* Paris green, arsenate of lead, calcium arsenate, sodium fluoride.

b. Contact insecticides. In general for use against insects with suck-

ing mouth parts and soft-bodied insects in general. *Ex.* Soaps, oils, lime-sulphur, and nicotine.

c. Fumigants. For the control of insects in enclosed spaces as in granaries, mills, warehouses, dwellings and specially constructed boxes. *Ex.* Hydrocyanic acid gas, carbon bisulphide, nicotine vapor, sulphur fumes, and heat.

d. Soil insecticides. To destroy insects living in the soil and which cannot be reached by other means. They may be poisons or contact insecticides, but more often they kill by asphyxiation. *Ex.* Carbon bisulphide and sodium cyanide.

e. Repellents. Materials which are distasteful or which may otherwise be repellent to insects. *Ex.* Bordeaux mixture, for flea beetles, creosote compounds for protecting cattle from flies, pennyroyal and lavender oil as a repellent to mosquitoes.

f. Combinations. Combining two or more kinds of insecticides or insecticides and fungicides to destroy two or more types of insects or insects and plant diseases with a single application. *Ex.* Bordeaux mixture and arsenate of lead.

In discussing insect controls continued emphasis should be given the importance of the third step in insect control,—*application*. Thus, we should urge the use of good materials, proper equipment, promptness in treatment, and thorough and proper applications. The success of insect control, in the end, depends on the operator.

A REVISION OF THE NEARCTIC SPECIES OF THE GENUS GONIA (DIPTERA, TACHINIDAE).

BY J. D. TOTHILL,
Fredericton, N. B.

(Continued from Page 200)

5. **Gonia porca** Will.

Parafacials at narrowest point about three times the length of the second antennal segment and only slightly wider at the base of the antennae. Genal hairs pale yellow particularly in profile, similar hairs usually extending over the facialia outside the single inner row of stouter black ones. Third antennal segment black. Occipital pile white. Pleura with a conspicuous golden pile that extends with some degree of variation over the trochanters, coxae, femora, dorsal parts of the thorax and ventral parts of the abdomen. First vein without bristles, those on the third vein extending half way or less to the small cross vein. Abdomen yellow except for a black dorsal band that widens posteriorly to include part or all of the fourth tergum.

The pair of sternal lobes that may be considered as part of the genitalia are yellow whereas all the other species of this paper have them black. Forceps somewhat short, about three times the median width; in dorsal view hardly triangular in outline on account of the equal sides being somewhat broadly excised at the middle; dorsoventral flattening is notably absent in the basal half; the ventral profile is slightly arcuate toward the tip.

Redescribed from nine males taken at Lillooet, B. C., 8,000 ft.; London

Hill Mine, B. C.; Creede Pass, Colo; Tennessee Pass, Colo; and Truchas Peak, N. M.

The holotype and allotype, both from Mt. Hood, Oregon, were examined at the University of Kansas by Dr. J. M. Aldrich who writes "pleura and mesonotum also have yellow pile", which in itself suffices to identify the species.

6. **Gonia fissiforceps** n. sp.

Parafrontals at narrowest point about two and half times the length of the second antennal segment and very little wider at base of antennae than at vibrissae. Genal hairs black. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles; the third vein with a few bristles at the base only. Abdomen entirely black.

The forceps of the genitalia remarkable for their large size and on account of the apical incision extending slightly more than half way to the base. Ventral profile straight. The lobes of the last sternum are also remarkable for their unusual size and on account of a distinct median excision in the middle of their lower margin.

Holotype—♂, Lillooet, B. C., June 24, 1917, (Tothill); No. 782 in the Canadian National Collection, Ottawa.

Paratypes—5 ♂, Banff, Alta.; Marshall Pass, Colo.; Longmire, Wash.; and 60 Lake Basin, Calif. One paratype each in the United States National Museum and the California Academy of Sciences.

7. **Gonia distincta** Smith.

Parafacials at narrowest place not more than twice the length of the second antennal segment, becoming much wider toward the antennal base. Genal hairs fuscous. Pleura without golden pile. First vein without bristles, those on the third vein extending from half to three-fourths distance to small cross vein. Abdomen in the males yellow with a wide black dorsal stripe that spreads out posteriorly to cover part of the third and all of the fourth tergum, and with a median ventral longitudinal black stripe also, in the females black. In the females the second antennal segment is fully half the length of the third.

Forceps of medium length presenting a straight edge in profile on the venter; in dorsal view almost triangular in shape the two equal sides tapering gradually from base to tip.

Redescribed from five males and two females taken at Petersham, Mass.; Bar Harbour, Mt. Desert, Me.; Salisbury, N. B.; Aweme, Man.; and Allan, Sask.

The female from Petersham was compared with the type by Mr. C. W. Johnson.

8. **Gonia fuscicollis** n. sp.

Parafacials at narrowest point about two and a half times the length of the second antennal segment and notably wider at the antennal base than at the vibrissae. Genal hairs black. Third antennal segment black. Occipital pile brown this being in marked contrast to the usual white of other species. Pleura without golden pile, first vein destitute of bristles, the third vein with bristles extending almost half way to the small cross vein. Abdomen entirely black.

The forceps of the genitalia short and only slightly more than twice as long as the median width. In dorsal view tapering gradually from base to tip and with the tip broadly rounded. Ventral profile arcuate.

Holotype— ♂, La Fayette, Ind., April, 1916, (J. M. Aldrich); in the United States National Museum.

Paratypes— ♂, same data; No. 783 in the Canadian National Collection, Ottawa; ♂, same data, in the Collection of C. W. Johnson; 3 ♂, same data, in the United States National Museum.

9. **Gonia longiforceps** n. sp.

Parafacials at narrowest point equal to or slightly less than greatest eye width and only a little broader at antennal base. Genal hairs black or fuscous. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles; those on the third vein extending half way to the small cross vein or less. Abdomen variable in color most specimens being black with a small lateral yellow spot; a few specimens are entirely black and a few have the sides and venter yellow with a broad black median line widening out posteriorly.

Forceps long and slender being about five times as long as the median width. In dorsal view the sides taper abruptly at the base and then continue almost parallel to the apex. Viewed in profile the dorsal declivity starts well beyond the middle and the ventral edge is gently arcuate.

Holotype— ♂, Lethbridge, Alta., April 21, 1915, (E. H. Strickland); No. 784 in the Canadian National Collection, Ottawa. Bred from *Porosagrotis orthogonia*, one of the important western cutworms.

Paratypes—28 ♂, Aweme, Man.; Oxbow, Sask.; Lethbridge, Alta.; Cranbrook, Vernon, Chilcotin, Kamloops, Hammond and Vancouver, B. C.; Moscow Mt., Moscow and Boise, Ida.; an unnamed station in South Dakota; Reno, Nevada; Walnut Creek, Sierra Morena Mts., and Los Angeles, Calif. Sixteen paratypes in the Canadian National Collection, Ottawa. Paratypes in the United States National Museum and the Collection of C. W. Johnson.

10. **Gonia carinata** n. sp.

Parafacials at narrowest point about three times the length of second antennal segment and only slightly wider at the base of antennae than at vibrissae. Genal hair fuscous. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles; third vein with a few small bristles at base. Abdomen reddish yellow except for a dorsal and a ventral narrow black stripe and except for the last tergum which is black.

The forceps of genitalia remarkable for the long median carina that is as deep as the forceps are thick. Otherwise the forceps are long and narrow with the notch confined to the apical fourth and straight in ventral profile.

Holotype— ♂, Salt Lake, Utah, in the United States National Museum.

11. **Gonia sequax** Will.

Parafacials at narrowest point about three times the length of the second antennal segment and considerably wider at the base of antennae. Genal hairs pale yellow in profile an occasional hair toward the extreme base being fuscous. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles, those at the base of the third vein not extending beyond half way to the small cross vein. Abdomen yellow, except for a black dorsal band that widens posteriorly so as to include a little of the third and most, or all, of the fourth tergum.

The forceps short being scarcely more than twice as long as the median width. In dorsal view almost triangular the sides tapering gradually from a broad base to the tip. In profile the dorsal declivity starts just before the middle and in ventral profile slightly arcuate toward the apex.

Redescribed from nineteen males taken at Redlands, Calif.; Lindsay, Calif.; Colorado Springs, Fort Collins, Col.; Las Vegas, N. M.; Harlingen, Texas; Lyme, Conn.; Auburndale and Wollaston, Mass.; Naramata, B. C.; and Jordan, Ont.

The male specimen of the European *G. ornata* Meig. so determined by Bezzi resembles this species in the pale almost white genal hairs and in general coloring. It differs in having a longer second antennal segment, stronger black hairs on the parafacials outside the inner row, and in having the forceps longer both actually and in proportion to width.

12. **Gonia aldrichi** n. sp.

Parafacials at narrowest place from three to three and a half times the length of second antennal segment. Genal hairs black or fuscous. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles; those of the third vein confined to the basal third of the distance to the small cross vein. Abdomen black frequently with lateral spots of yellow that occasionally spread out so as to cover the venter and the lateral parts of the abdomen.

Forceps unusually robust being both long and wide. About three times as long as the median width and almost triangular in dorsal view the equal sides tapering gradually from the base to tip. The dorsoventral flattening is very marked.

Bred by Mr. E. H. Strickland from *Euxoa ochrogaster* and from *P. orthogonia*, these being important cutworms in Alberta.

Holotype— ♂, Coaldale, Alta., April 26, 1915, (E. H. Strickland); No. 786 in the Canadian National Collection, Ottawa.

Paratypes—49 ♂, Fredericton, N. B.; Hull, Que.; Ottawa and Jordan, Ont.; Lethbridge, Alta.; Chilcotin and Kaslo, B. C.; Essex, Wollaston, Auburndale, Hyde Park and Beverley, Mass.; Rock Creek, D. C.; Oswego, N. Y.; Mt. Vernon, Va.; Lafayette, Ind.; Moscow, Ida.; Logan, Utah; Montana Exp. Sta.; Malcolm, Neb.; Denver, Colo.; and Pullman, Wash. Three paratypes in the Collection C. W. Johnson; one in the Museum of the Boston Society of Natural History and sixteen paratypes in the United States National Museum. Named in honour of Dr. J. M. Aldrich.

In addition to this material there are four males from North Dakota, Iowa and Ontario that have narrower parafacials. These may represent another species but I have been unable to determine their status.

13. **Gonia frontosa** Say.

Parafacials at narrowest point about two and a half times the length of the second antennal segment and somewhat wider toward the antennal base. Genal hairs fuscous. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles; those on the third extending for less than half the distance to the small cross vein. Abdomen usually black frequently with a dull reddish yellow spot laterally.

Forceps short and ventral margin arcuate in profile. In profile the dorsal declivity starts at or slightly before the middle. A dorsoventral flattening quite evident at the base.

Closely resembles *G. breviforceps* n. sp., but distinguished by the narrower parafacials and arcuate forceps.

Redescribed from more than a hundred males taken at Jordan and Ottawa, Ont.; Aweme, Man.; Vancouver, B. C.; and taken in Mass., N. H., Conn., N. J., D. C., Ind., Va. (Plummers Island), Ind., Ill., Ida., and Wash.

Say's type material from the "Upper Missouri River" being no longer extant this species has been chosen as the one most likely to have been described by Say. A specimen from Manitoba selected as a neotype (No. 785), is deposited in the Canadian National Collection, Ottawa.

14. **Gonia yukonensis** n. sp.

Parafacials at narrowest point about two and a half times the length of second antennal segment and very little wider at base of antennae than at vibrissae. Genal hairs fuscous. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles, a few bristles at base of third vein. Abdomen black.

The forceps of genitalia somewhat thick-set with but little dorsoventral flattening; ventral surface straight in profile; the notch extending about one third the distance to base; in dorsal view the sides tapering somewhat gradually from base to tip.

Holotype— ♂, Yukon Terr., 1916, (D. D. Cairnes); No. 786 in the Canadian National Collection, Ottawa.

Paratype— ♂, Tenessee Pass, Colo., (J. M. Aldrich); in the United States National Museum.

The Colorado specimen has black palpi, and, when further material is available, may prove to be a new but closely related species.

15. **Gonia breviforceps** n. sp.

Parafacials at narrowest point fully three times the length of second antennal segment and only a little less than greatest eye width. Genal hairs black of fuscous. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles, those of third vein usually confined to the basal third of distance to the small cross vein. Abdomen black with yellow spots that occasionally spread over the sides of the abdomen.

Forceps short, the ventral margin straight in profile, the dorsal margin in profile showing the declivity starting at or close to the middle. About two and a half times as long as the median width. In dorsal view the two equal sides taper somewhat abruptly from the base to middle after which they are practically parallel almost to the tip.

Holotype— ♂, Lethbridge, Alta., April 15, 1915, (E. H. Strickland); No. 788 in the Canadian National Collection, Ottawa.

Paratypes—28 ♂, Oxbow, Sask.; Banff and Lethbridge, Alta.; Lytton, Vernon and Cranbrook, B. C.; Boseman, Mont.; Austen Co., Col.; and Los Angeles, Calif. Seventeen paratypes in the United States National Museum; ten paratypes in the Canadian National Collection, Ottawa; one paratype in the Collection of C. W. Johnson.

This species might easily be confused with *G. aldrichi* n. sp. but is readily distinguished by reference to the forceps.

16. **Gonia longipulvilli** n. sp.

Parafacials at narrowest point about three times the length of the second antennal segment and considerably wider toward the antennal base. Genal hairs pale fuscous, in a few specimens becoming pale yellow in profile. Third antennal segment black. Occipital pile white. Pleura without golden pile. First vein without bristles; those on the third vein confined to the basal third of the distance to the small cross vein. Abdomen reddish yellow except for a narrow median black dorsal stripe that broadens posteriorly to include part of the third and all of the fourth tergites; the ventral margins of the tergites and all of the sternites yellow.

The forceps about three times as long as the median width tapering abruptly on the sides to the middle after which the sides are approximately parallel almost to the apex. The ventral surface presents a straight edge in profile. The dorsal edge in profile shows the declivity starting well beyond the middle.

Holotype—♂, Royal Oak, B. C., June 30, 1917, (B. H. T.); No. 789 in the Canadian National Collection, Ottawa.

Paratypes—12 ♂, Minot, N. D.; Moscow, Ida.; Tempe, Ariz.; Lake Co., Cal.; Mexico City, Mex.; Lethbridge, Alta.; Vancouver and Royal Oak, B. C. Six paratypes in the Canadian National Collection and six in the United States National Museum.

17. **Gonia brevipulvilli** n. sp.

Similar to *G. longipulvilli* n. sp. but the black markings on the abdomen are more extensive; the sternites and usually the ventral margins of the tergites are black, and the pulvilli and tarsal claws are both shorter than the last tarsal segment.

Holotype—♂, Fredericton, N. B., May 3, 1912, (J. D. Tothill); No. 790 in the Canadian National Collection, Ottawa.

Paratypes—11 ♂, Fredericton, N. B.; Melrose Highlands, Mass.; Rock Creek, D. C.; Lafayette, Ind.; Brookings, S. D.; Reno, Nev.; and Boulder, Colo. Two ♂ in the Canadian National Collection and nine ♂ in the United States National Museum and Collection of C. W. Johnson.

SUMMARY OF DISTRIBUTION.

G. porca	Colo., N. M. (above tree line), Ore.	Arctic zone
G. yukonensis	Colo. (above tree line), Yukon	" "
G. sequax	Ont., B. C., Conn., N. D., Colo., Tex., N. M., Cal.	North America
G. distincta	Mass., Me., N. B., Man., Sask.	Transitional and boreal N. A.
G. aldrichi	N. B., Que., Ont., Alta., B. C., Mass., D. C., N. J., Va., Ind., Ida., Utah, Mont., Neb., Colo. Wash.	Transitional and boreal N. A.
G. frontosa	Ont., Man., B. C., Mass., N. H., Conn., N. J., D. C., Md., Va., Ind., Ill., Ida., Wash.	Transitional and boreal N. A.

G. brevipulvilli	N. B., Mass., D. C., Ind., S. D., Nev., Colo., B. C.	Transitional and boreal N. A.
G. fissiforceps	B. C., Alta., Colo., Wash., Cal.	Western
G. longiforceps	Man., Sask., Alta., B. C., Ida., S. D., Nev., Cal.	Western
G. breviforceps	Sask., Alta, B. C., Mont., Colo., Cal.	Western
G. longipulvilli	Cal., Colo., N. D., Ida., Ariz., Mex., Alta., B. C.	Western
G. turgida	Nev., Cal.	Southwestern
G. senilis	Md., N. J., Va., Ga., Fla., Kans.	Central and Eastern, south of transitional zone.
G. sagax	Conn., N. J.	Eastern, south of transitional zone.
G. carinata	Utah	?
G. fuscicollis	Ind.	?
G. setigera	Mass., Cal.	?

THE NORTH AMERICAN AND GREENLAND SPECIES OF SYMPISTIS (LEPIDOPTERA.)

BY WM. BARNES AND F. H. BENJAMIN

Decatur, Ill.

Sympistis lapponica Thun.

1791, Thun., Diss. Ent., II, 42, f. 10, *(Noctua.)*
amissa Lef. (partim.)

1836, Lef., Ann. Soc. Ent. Fr., p. 397, pl. X, f. 6 ♂, (nec ♀), *(Anarta.)*
melanopa var. b. Zett.

1840, Zett., Ins. Lapp., p. 950, *(Anarta.)*
form *tenebricosa* Moesch.

1877, Moesch., Stett. ent. Zeit., p. 498, *(Anarta.)*

Specimens received from Staudinger and Bang-Haas indicate that the name *tenebricosa* can stand for the form of the species with the primaries practically lacking the grey irroration prominent in the typical form. The authors have seen *tenebricosa* only from Lapland and Greenland.

Sympistis zetterstedtii Staud.

1857, Staud., Stett. ent. Zeit., p. 294, *(Anarta.)*

Five European specimens are before the authors, one received from Staudinger and Bang-Haas. It is not in the Barnes Collection from North America. Perhaps North American records refer to *labradoris* or *wilsoni*.

Sympistis zetterstedtii race *kolthoffi* Auriv.

1890, Auriv., Bih. K. Vet. Akad. Handl., XV, pl. II, f. 1, pl. III, f. 2 ♂ genitalia, *(Anarta.)*

One specimen from Greenland, and one specimen without data are in the Barnes Collection. The basal, t.a., medial, s.t., and terminal areas contrast with one another, the medial tending to be darkest, thus differing from the nearly unicolorous *zetterstedtii*. It is, also, somewhat larger. It is quite likely a distinct species, thus far found only in Greenland. The series in the Barnes Collection is too limited to satisfactorily determine if *kolthoffi* is conspecific with *zetterstedtii* or not. It appears to be at least a valid subspecies.

According to Aurivillius (1890), *amissa* Lefebvre (partim), (1836, Let., Ann. Soc. Ent. Fr., p. 397, pl. X, f. 7, ♀ (nec ♂,) is a synonym.

Sympistis zetterstedtii race *labradoris* Staud.

1901, Staud. Cat. Lep. Palae., I, 219, No. 229la, *zetterstedtii* var., *(Anarta.)*

Two specimens received from Staudinger and Bang-Haas confirm the usual conception of this race or species. It is not found in Europe, and will probably ultimately prove to be a distinct species.

Sympistis besla Skinner and Mengel.

1852, Skinner & Mengel, Proc. Ac. Nat. Sci. Phila., p. 158, *(Anarta.)*

This name has been omitted from all subsequent literature available to the authors. Through the kindness of Dr. Skinner, the authors possess one of the types ; a specimen in the Academy of Natural Sciences is to be made the lectotype by Dr. Skinner, who states that the specimen he sent matches the proposed lectotype.

The insect is a *Sympistis,* perhaps more closely related to the Greenland *kolthoffi* than to any other described form. It is smaller than that insect, with almost unicolorous wings, the primaries lacking the darker median and paler terminal areas of *kolthoffi.*

In superficial appearance, the primaries bear some resemblance to *Anarta subfumosa* Gibson, but the secondaries are practically unicolorous except for a small white area along the costal margin.

Sympistis wilsoni sp. nov.

Antennae simple, ciliated. Head and thorax black mixed with olive. Primaries: ground color black; basal line obscured; t.a. line black, preceded by a pale shade, waved from costa to inner margin ; orbicular and reniform pale greyish-white, filled in with fuscous, the former somewhat longitudinally flattened, the latter upright, rather large for the group ; a black shade connects the stigmata, and the reniform with the t.p. line ; claviform grey-white, large, clearly defined, faintly outlined by some black scales, connected to the t.p. line by a black bar ; t.p. line black, followed by a pale shade, slightly oblique inwardly from costa to radius, thence extending distad, parallel to inner margin to near end of cell, produced to points on the veins, excurved to about vein 3, thence incurved ; s.t. line obsolescent, mainly marked by scattered fuscous scaling, with a black patch on the costo-radial region, a sagittate black dash between veins 3 and 4, and a conspicuous black sagittate dash, marked distally by pale scaling, in the submedian fold ; a thin terminal black line, more or less broken into dots by the veins ; fringe black, faintly checkered by a few white cilia. Secondaries : black, entirely unicolorous except the fringe which is white from below apex to a little past the anal angle, marked by considerable black at the apex, strongly tinged with fuscous from near anal angle to inner margin. Beneath : blackish ; primaries marked by the t.p. line and its accompanying white shade showing through; fringe checkered black and white: secondaries with a thin upright black discal mark, connected to the base by a black bar ; with a trace of a pale median shade ; fringe as on upper side. Expanse : 26 mm.

This species was placed under the name *lapponica* in the Barnes Collection; but close examination shows it quite distinct. It is more closely allied to *tenebricosa* than to typical *lapponica.* From *tenebricosa* it differs in larger size ; larger ordinary spots ; distinct, outlined, claviform, instead of scattered scaling ; and

unicolorous secondaries showing no trace of white on the upper surface. On the under side the differences are even greater, *lapponica* being a brilliant black and white insect, form *tenebricosa* with the white only slightly reduced ; whereas in the present species the white is obsolescent, only showing as a faint common shade across the wings. It is the only species of *Sympistis* known to the authors with the discal mark on the under side of the hind wing connected to the wing base by a distinct black bar.

A female in the Canadian National Collection from Mt. Cheam has the claviform reduced, but is probably conspecific with the holotype.

Type locality : Mt. Cheam, B. C. (Bush-Wilson).

Number and sexes of types : *Holotype* ♂—14-VIII-11 ; 1 ♂, *Paratype*, 9, VIII, 07.

Type in Coll. Barnes, Paratype in Canadian National Collection.

Sympistis funebris Hbn.

1804, Hbn., Schmett. Eur., Noct., f. 433, *(Noctua.)*

funesta Payk.

1793, Payk., Skriv. Nat. Sels., p. 100, pl. II, f. 3. *(Noctua.)*

The name *Noctua funesta* Payk. (1793) is a homonym of *Noctua funesta* Esp. (1786), is sunk by Staudinger (1871, Cat. Lep. Europ. Faun., I, 1128, " sed Funesta Esp. alia erat noctua"), is again sunk by Staudinger and Rebel (1901, Cat. Lep. Palae., I, 219), and is unavailable under the International Rules (Article 36).

The authors see very little difference between a specimen from Yellowstone Park, which has been compared with the type of *cocklei* Dyar (1904, Can. Ent., XXXVI, 31, *Homohadena*), and European specimens; but hesitate to sink the name as a straight synonym because of the lack of sufficient material from British Columbia. Tentatively, the name *cocklei* may best be retained as a race of *funebris.*

The named American and Greenland species and forms may be separated as follows[1] :

I.—Hind wing with central area and inner margin near anal angle white *melaleuca*

II.—Not so, hind wing usually black brown ; often marked with white as far as vein 2, or with a white central area,

A.—Upper side of hind wing marked by at least some white, the white often restricted to the costal margin,

a.—Upper side of hind wing with a distinct white patch on costal area, sometimes extending as a narrow band to vein 2,

a[1].—Fore wing strongly irrorated with grey-white ..... *lapponica*

b[1].—Fore wing only slightly irrorated with grey-white .... *tenebricosa*

b.—Upper side of hind wing with white on costal area either wider in extent—but never as a clearly defined patch, rather as a suffusion, seldom extending into the central area of the wing—or with the white occupying the whole central area of the wing,

1.—Specimens compared with the types involved show that the species listed by Barnes and McDunnough, Check List, as No. 2199, "*Sympistis kelloggi,*" and described as *Anarta kelloggii* Hy. Edw., (1876, Proc. Calif. Ac. Sci., VI, 133), is the same as No. 2021, *Oncocnemis;* the name *kelloggii* having priority. The original orthography of the "*ii*" termination should be preserved.

a^1.—Fore wing with some transverse maculation usually visible.
a^2.—Central area of hind wing black or blackish,
a^3.—Fore wing without contrasting areas ..... *zetterstedtii*
b^3.—Fore wing with contrasting areas ..... *kolthoffi*
b^2.—Central area of hind wing white ..... *labradoris*
b^1.—Fore wing with no transverse maculation visible; practically unicolorously blackish-brown ..... *besla*
B.—Upper side of hind wing wholly black-brown,
a.—Central area not disconcolorous with basal and terminal areas .. *wilsoni*
b.—Central area of primaries disconcolorous, darker than the basal and terminal areas ..... *funebris*
cocklei

SOME APPARENTLY NEW CANADIAN PSYCHODIDAE (DIPT.)*

BY C. HOWARD CURRAN,
Ottawa, Ont.

Owing to the very great care necessary in the collection of these pretty little flies they are not usually numerous in collections. Perfect specimens may be obtained only by taking care not to place more than half a dozen specimens in a vial and to mount them while fresh. The family is little known in America, although over fifty species have been described from the northern half of the continent. In most cases these have been collected in rather restricted areas and the number of species as yet undescribed must be large.

Because of the rather unsatisfactory state of the literature, determination of specimens is difficult. Most emphasis has been laid on the arrangement of the hairs on the wings, their color and color of hair on other parts of the body. These characters prove to be variable in the same species and sexual dimorphism is not uncommon. Integumental color, on the other hand, appears to be reasonably constant, especially as applied to the appendages. It will be found difficult to trace out American specimens in the available keys, the most outstanding characters having been given secondary consideration.

In many cases it will be difficult to decide whether a species belongs to the genus *Psychoda* or *Pericoma*, as the crossveins[1] used as the character separating the two genera are usually weak and covered, in many cases by dense hair. Even when the wings are denuded in this region, there may be difficulty in arriving at a decision. I have specimens in which these veins are strong while in others of the same species they are entirely wanting. The antennae are not much more satisfactory as there is an absolute intergradation. It is therefore somewhat doubtful whether anything is to be gained by recognizing the genus *Pericoma* and I am not making use of it at present but the species falling into this group are indicated in the following descriptions.

I am unable to place the species described below, but some may prove to have been already described. If so they are not clearly recognizable because of certain omissions in the descriptions or overemphasis of some variable character. The wings are measured from the "ridge," not the base.

1. See Williston, Man. N. A. Dept., 1908.

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

KEY TO RECOGNIZED SPECIES.

1. Posterior tarsi wholly pale yellow, the tibiae wholly black, *albitarsis* Banks
   Posterior tarsi not wholly pale yellow, if so the femora or tibiae broadly or wholly pale, wings very dark 2
2. Posterior tarsi annulate with black and silvery white or yellow. 3
   Posterior tarsi unicolorous or dark at base or apex; not annulate 5
3. Second joint of the front 4 tarsi practically all silver white due to hair, the femora brown 4
   Second joint of middle tarsi black, the femora pale yellow, *megantica* n. sp.
4. First joint of front tarsi silvery white on apical half, ... *scotiae* n. sp.
   First joint of front tarsi black or brown on apical half, ... *variegata* Kin.
5. Antennae thick due to the flagellar nodules being more or less connected by their pile 8
   Antennae slender, their hairs isolated or not appressed 6
6. Face with brown hair ..... *criddlei* n. sp.
   Face with whitish hair 7
7. Sides of abdomen and venter with abundant deep brown, appressed hair, the middle of the venter with appressed, silvery white hair extending over the apex to the dorsum ..... *orillia* n. sp.
   Sides of abdomen at most narrowly brownish pilose, the pile on the antennae short, sparse ..... *alberta* n. sp.
8. Femora yellow at least on basal half 11
   Femora brown, not yellow in ground color 9
9. Wings wholly unicolorous greyish, the pile not bunched .... *prudens* n. sp.
   Wings blackish or with black and white 10
10. At least apical half of dorsum black pilose above, ... *varitarsis* n. sp.
    Abdomen as described in couplet 7 ..... *orillia* n. sp.
11. Tips of several veins with small condensation of black or brown hair .... *nocturnata* Hase.
    Tips of veins without these spots 12
12. Thorax and abdomen deep brownish ..... *cinerea* Banks ?
    Thorax and abdomen chiefly ferruginous to yellowish ..... *minuta* Banks

Psychoda (Pericoma) scotiae n. sp.

Length of wing, 1.75 to 2 mm. *Male.* Integument brownish. Head with short white hairs, appressed except just above the antennae and on the occiput; eyes moderately separated. Antennae yellowish brown, the first three segments darker, with appressed white hair, the flagellar segments with short white hairs and sparse, longer blackish ones.

Thorax with moderately short white hair, but this is long and in large part greyish behind the base of the wings and longer on the pleura.

Legs blackish, the tibiae and part of the tarsi paler, but the pale parts appear silvery white. Femora covered with appressed white hair practically concealing the ground color on the basal two-thirds, the apical one-third or less with more erect brown hair and in addition there are several long white hairs, most numerous on the anterior surface; immediate apices of all the tibiae silvery

white; second joint of all the tarsi silvery white, except that they may be brownish on the lower edge behind and ventrally, and the broad apex of the first tarsal joint is also white, the hind ones often wholly silvery on the anterior surface and upper surface in front, rarely almost all silvery; the subapical two joints are deep black, the apical one black with rather golden reflections.

Wings with longish black hairs, the tips of the second and third and seventh to ninth veins with white hair, and areas of white hairs as follows; a patch resting on the basal angulation, a broad fascia just before the middle and another irregular interrupted one on the apical third, this latter wider and nearer the apex in front, narrower and more basal behind the interruption, the fringe also white on broad apex and basal third in front and sub-basal sixth behind. This latter connected with the basal white patch. The fringe is brown, short in front, increasing in length from apex to base behind; nowhere as long as one-third the wing width. Squamae whitish, brown on surface towards the wing. Halteres brown, with white hair.

Abdomen wholly clothed with whitish hair, thinner on dorsum and not long. Genitalia markedly distinctive.

Female. The hair on the thorax is darker and largely mixed with brownish, the brown area being larger, the brown squamae with long white pile which appears as a mesonotal white patch on either side.

Legs very similar with longer and more abundant erect white hairs on the tibiae and the apex of hind tibiae is not silvery, the base of their tarsi broadly so, the first joint of the hind pair with a black band before the middle.

Wings darker, the white fasciae not nearly so wide, and only a little white hair on the fringe sub-basally; the fringe is twice as long as in the ♂, the apical white area much smaller. Abdomen with longer white hair above, and a few black hairs toward the venter. Ovipositor brown, moderately short, not much curved.

Holotype—♂, Annapolis Co., N. S., Aug. 12, 1923; No. 760 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—5 ♂, same data, 3 ♂, 4 ♀, Hull, Que., July 8, 1923, (Curran).

The Nova Scotia material was submitted for determination by Prof. W. H. Brittain of Truro.

Psychoda (Pericoma) megantica n. sp.

Length of wing 2.25 mm. *Female*. Integument brownish. Antennae yellow, becoming brownish at apex; eyes narrowly separated; head and thorax otherwise as in *scotiae*.

Femora and more than the basal half of the tibiae pale yellow, with pure white hair, the tibiae with some long whitish hairs, their subapical fourth with longer, more erect brownish hair, the immediate apex again yellow and with scale-like silvery white hairs; tarsi black, the apical third of the first joint silvery white.

Wings with black hair, the immediate base, a sub-basal narrow fascia widened at either end, a pre-median broad fascia, connected with the basal one along the costa, an entire broad post-median fascia extending over the costa

and hind margin and the tips of the second and third and sixth to eighth veins white haired; marginal fringe white from second to sixth veins excpt a few brownish hairs between the veins, almost the basal half of the costa except a few brown sub-basal hairs and the basal third of the hind margin white haired. Fringe on costa one-third, on hind margin about one-half width of wing.

Abdomen with erect whitish hair, the venter with appressed, pale hair largely intermixed with brown. Ovipositor yellowish, long, rather slender.

Holotype— ♀, Megantic, Que., June 20, 1923, (Curran); No. 761 in the Canadian National Collection, Ottawa.

Psychoda albitarsis Banks.

The ♂ has a large hemispherical tuft of black scale-like hairs below the humeri which is remarkably prominent. A pair from Hull, Que., (Curran).

Psychoda (Pericoma) orillia n. sp.

Legs wholly black but with golden or silvery reflection in certain lights, the wings brownish, with brown hair, only the fringe at apex white.

Length of wing 2.25 mm. *Female*. Integument dark brown. Eyes very narrowly separated; head before the antennae with greyish appressed hair, which may appear rather white or brownish from different angles; occiput with short whitish hair.

Thorax with short white hair, almost bare behind; the base of the wings have white hair appearing to rise from the sides of the mesonotum but a few of the hairs are brownish and some of the hairs on the squamae are brown. Pile of pleura fine, white, outstanding, long.

Legs blackish; the femora with whitish hair; tibiae with long brown hair on either side; a few long brown hairs on tarsi above. Tibiae and tarsi with silvery reflections in some lights, golden in others.

Wings uniform brownish, with uniform moderately long, fairly abundant brown pile, the base before the angle and the broad apex with white hair. Costal fringe one-third, posterior fringe one-half wing width.

Abdomen with the dorsum and genital region white haired, the sides and venter black haired. Ovipositor yellowish, slender.

Holotype— ♀, Orillia, Ontario, July 15, 1923, (Curran); No. 762 in the Canadian National Collection, Ottawa.

Psychoda (Pericoma) criddlei n. sp.

Legs brown, with very abundant long golden brown hair, the tarsi with a dense crest of similar pile; head black pilose; wings largely brown-haired.

Length of wing 2.75 mm. *Male*. Integument wholly brown, including antennae and legs. A very hairy species. Head with dense, erect brown hair. Eyes very narrowly separated. Basal antennal joints with dense brown hair, the others with more sparse paler hairs.

Thorax with long, erect brown hair before the wings and long greyish white behind them.

Legs brown, the femora with appressed, long, brownish tinged or brownish pile, the tibiae with very long, abundant rather golden brown pile, the tarsi with

a dense wide crest of similar pile above, the pile longer and more abundant on the front legs.

Wings with long brown pile, the sub-basal area largely white-haired and patches of similar colored hair as follows: a spot at apical third behind costa, another larger one on the hind margin just basad of this, and a minute one just inside its anterior corner. Costal fringe pale brownish; apex of wing broadly white, and another white area between the 7th and 9th veins. Squamae brown with brown pile but a few white hairs in the middle. Halteres brown with short, appressed white hair.

Abdomen wholly white pilose.

Holotype— ♂, Aweme, Man., Aug. 2, 1917. (N. Criddle); No. 763 in the Canadian National Collection, Ottawa.

Paratypes—4 ♂, same data.

Psychoda (Pericoma) alberta n. sp.

Tarsi unicolorous, dark; body and legs entirely clothed with yellowish tinted whitish pile; wings blackish haired with white fasciae.

Length of wing 2.25 mm. *Male.* Integument all brownish, pile yellowish white. Antennae reddish brown, white haired, the flagellar segments with fairly abundant erect black hairs. Face with appressed hair, the front and occiput with rather abundant erect hair, the eyes narrowly separated.

Hair on thorax slightly tinged with grey between the partly grey-haired squamae which are, however, white haired on the outer half.

Femora with rather short appressed hair, the tibiae with similar, shorter hair and long white hairs on anterior and posterior surfaces, their tarsi with a row of such hairs along the upper surface. Tarsi brownish with an obscure golden yellowish reflection, the narrow apex of the tibiae somewhat silvery so that the base of the tarsi appear very narrowly silvery.

Wings chiefly black-haired, the basal ridge, a wide fascia on the anterior two-thirds narrowly separated from the basal fascia on its anterior half, except along the costa, and a broad median fascia which curves basad behind and ends behind the sub-basal fascia, white haired, the apex of the wing widely and the base of the costa above, also white haired. The basal third of the wing may be described as white haired on the upper surface, with a roundish black spot just beyond the ridge. Costal fringe one-fourth, posterior fringe one-third as wide as wing.

Abdomen with a few greyish hairs laterally.

Female. The wings are darker as the pale fasciae are not much more than half as wide as in the ♂ and the basal ones are not normally connected. In one specimen the fasciae are nearly as wide as in the ♂ but not connected.

Holotype— ♂, Waterton Lakes, Alta., July 10, 1923, (J. McDunnough); No. 764 in the Canadian National Collection, Ottawa.

Allotype— ♀, same data, July 6.

Paratypes— ♂, 2 ♀, same data as allotype.

Psychoda prudens n. sp.

Wings wholly cinerous haired; integument wholly pale brown.

Length of wing, nearly 3 mm. *Female.* Pile cinereous, white on base of

abdomen and legs. Pile on face sub-appressed; elsewhere on head erect, short; eyes almost touching above. Antennae almost as long as thorax and abdomen, greyish haired, appearing of equal width throughout, apparently thick, the basal segments not quite as wide as the flagellar nodes.

Pile on thorax moderately long and dense.

Femora and tibiae with appressed hair, the hind tibiae and tarsi especially with long pale hair above, rather silvery grey in certain lights.

Wings cinereous, the base yellow, the hairs wholly cinereous, fairly abundant. Wings acute. Fringe one-third wing width behind, not over one-fourth on costa.

Holotype— ♀, Nordegg, Alta., July 3, 1921, (J. McDunnough); No. 765 in the Canadian National Collection, Ottawa.

Paratype— ♀, June 30, 1921, same data otherwise.

Psychoda varitarsis n. sp.

Antennae and abdomen brownish black pilose; wings greyish black with two black patches. Tarsi appearing yellowish due to scale-like pubescence.

Length of wing 2.2 mm. *Male.* Integument brown. Pile of head brownish, moderately long on face, appressed, elsewhere erect. Eyes practically contiguous above. Antennae almost as long as thorax and abdomen, the hairs on the thick flagellar segments not appressed, but some of them oblique, the antennae therefore appearing very thick, the hairs rather brownish but with some grey reflections.

Pile on thorax rather greyish yellow, a brownish tuft on the sides above before the wings and a few similar hairs behind laterally; the brown squamae are brownish pilose.

Legs brown, the femora with fairly abundant, sub-appressed brownish or brownish white pile, the tibiae with similar colored, sub-erect rather abundant pile, the hind ones especially, with several long pale hairs postero-dorsally, their basitarsi with several longish black hairs behind. The tarsi are brown basally but appear to become yellow at the apex; clothed with silvery yellowish scale-like appressed hairs.

Wings greyish black, the fringe and two spots on apical third blackish. Costal fringe one-third, posterior one-half as long as width of wing, the apex moderately rounded.

Abdomen black pilose, the basal hairs somewhat paler.

Holotype— ♂, Megantic, Que., June 18, 1923, (Curran); No. 766 in the Canadian National Collection, Ottawa.

Paratype— ♂, same data.

Taken on foliage along stream in thick woods.

A CORRECTION.

On page 155 of the July number the name *Erythroneura fulvocephala*, proposed for a new species, should be changed to *Erythroneura xanthocephala*. The error was due to an oversight in proof reading. W. ROBINSON.

NEW NORTH AMERICAN EPHEMERIDAE.*

BY JAMES MCDUNNOUGH,
Ottawa, Ont.

Leptophlebia associata n. sp.

Male. (alcoholic specimen) Thorax deep black brown; abdomen brown, semitranslucent on the anterior segments and opaque on the three posterior segments which are a ruddier brown than the preceding ones. Forceps light brown. Wings hyaline, slightly tinged with amber color and with the pterostigmatic region decidedly brownish. Length of body 8 mm.; of forewing 8 mm.

Holotype—♂, Fry's Harbor, Santa Cruz Is., Calif., (C. H. Kennedy); No. 818 in the Canadian National Collection, Ottawa.

Paratypes—13 ♂, same data, in the Canadian National Collection and collection of C. H. Kennedy.

The species is allied to *gregalis* Eaton, as I have determined it from specimens collected in Santa Clara Co., Calif., by C. H. Kennedy which agree well with Eaton's original description. In *gregalis* the inferior processes of the penes are long and acuminate whereas in *associata* they are short and of equal width throughout; the apices of the penes (fig. 4) are also bent inward and closely approximate in the latter species, a feature not found in *gregalis*.

Leptophlebia brunneipennis n. sp.

Male. Head and thorax blackish, abdomen deep red-brown, the last ventral segment and the bifid subgenital plate blackish, forceps paler brown, penes only united at the extreme base, slender and slightly bent outwards apically, the whole organ in the shape of the letter U; setae pale smoky brown. Forelegs deep blackish-brown, the tarsi somewhat paler; four posterior legs with femora brown, tibiae somewhat paler, more golden brown. Wings unicolorous deep amber, the crossveins very numerous; about 14 costal veins before the bulla and 23 or more beyond it, many of these latter anastomosing. Length of body 7 mm.; of wing 8 mm.

Holotype—♂, May 30, 1914, Rock Lake, Wash., (A. L. Melander); in Washington State College collection, Pullman, Wash.

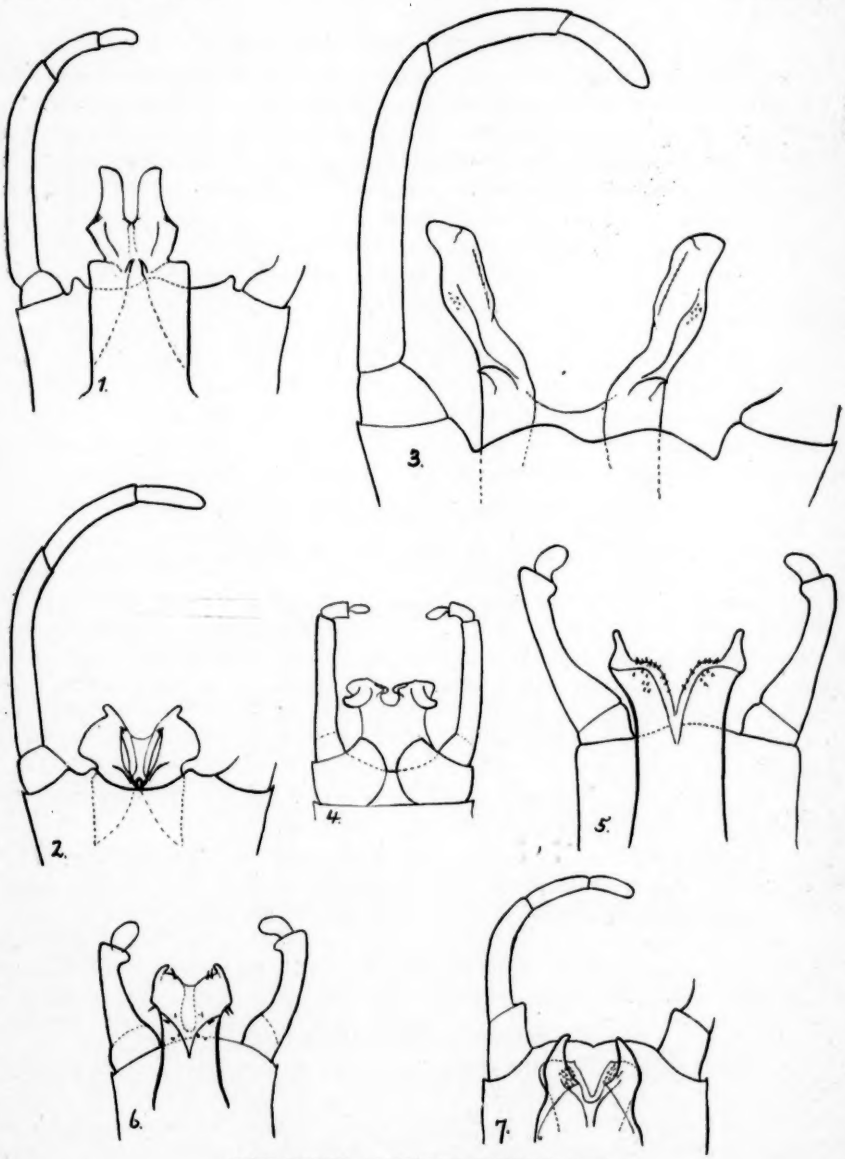
Paratype—♂, same data; No. 793 in the Canadian National Collection.

I had at first considered the specimens to be the males of *rufivenosa* Eaton, described from females alone; I believe now however that I have correctly identified this latter species with a female from Vancouver Island, B. C. If I am correct *brunneipennis* may readily be distinguished by the large number of costal and other cross veins as well as by the very deep amber color of the wings.

Choroterpes albiannulata n. sp.

Male. (in alcohol). Eyes rather flat, oval, deep red-brown; head blackish with bases of antennae tinged with orange; pronotum black with posterior margin centrodorsally tinged with orange; meso- and metanotum deep black, edged with a pale lateral line anterior to base of wings; pleura tinged with orange, especially in the vicinity of the above mentioned pale streak; sternum blackish with bases of legs orange tinged. Abdomen dorsally black-brown, with posterior margin of

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.



NEW NORTH AMERICAN EPHEMERIDAE.

each segment narrowly but very distinctly whitish; faint traces of dark geminate dorsal streak and a small dark blotch on each segment in the stigmatal area; ventrally paler, semitranslucent smoky, the posterior margin ringed with white as on dorsum, this color tending to spread forward in the medioventral area, especially in segments 7-9 which are largely white; traces of three narrow medioventral longitudinal lines, most distinct on anterior segments; setae brownish, forceps and penes basally smoky brown, apically white, the second joint of the former much dilated basally. Foreleg with brown femur and tibia, marked with black-brown at the joint; tarsi whitish; hind legs with tibia also largely whitish. Wings vitreous with small brown patch at base of primaries. Length 5 mm.

Holotype— ♂, Medicine Hat, Alta., Aug. 23, (F. S. Carr); No. 1237 in the Canadian National Collection, Ottawa.

Ephemerella infrequens n. sp.

Male. Head light brown with pale yellowish clypeus and bases of antennae; eyes (living) light orange; the pronotum and lateral edges of mesonotum anterior to base of wings purplish brown, mesonotum deep olive brown, shading into ruddier brown posteriorly and with two slightly raised blackish lines just anterior to the scutellum; lateral sutures and bases of wings slightly tinged with ochreous; prosternum yellowish, remainder of sternum brown; legs light yellow, the fore tibiae and tarsi somewhat duller in color than the femora, tarsal joints slightly marked in brown. Abdomen dorsally rather light red-brown with smoky segmental incisures, scarcely paling posteriorly, a narrow yellowish line along lateral edge; ventrally dull purple brown, shading into ochreous brown on posterior segments and with central segments showing traces of pale semitranslucent areas along anterior margins. Forceps ochreous, penes similar with a darker transverse band near base; setae with basal joints yellowish, remainder whitish, narrowly ringed with deep brown. Wings hyaline with pale veins, the crossveins being indistinct, especially in basal costal area. Length of body 8 mm., of forewing 9 mm.

Holotype— ♂, Waterton Lakes, Alta., July 14, (J. McDunnough); No. 816 in the Canadian National Collection, Ottawa.

Paratypes— ♂, same data; ♂, Lake Tahoe, Calif., (Coll. Hubbard and Schwarz) in the United States National Museum.

The species is allied to *invaria* Wlk. showing the same type of apically enlarged second joint of the male forceps but differing in shape of penes (fig. 6) and the ruddier color of the abdomen; it is also close to *inermis* Eaton, from Colorado, in general shape of the penes but this latter species is without the enlarged apical section of the second joint of the forceps. According to Ulmer's key (1920, Stett. Ent. Zeit. 81, 119) *infrequens* would fall into the genus *Chitonophora* Bgtss., but I doubt whether his definition of *Ephemerella* is based on an actual knowledge of the genotype, *excrucians* Walsh, and for the present prefer to include all our North American species under the one generic term.

Ephemerella norda n. sp.

Male. Thorax deep brown, blackish in the median area, shaded laterally below base of wings with ochreous. Abdomen dorsally deep brown with darker segmental joinings and a narrow yellowish lateral area, shaded with ruddy on

three posterior segments; traces (more distinct in older specimens) of a dark, partly geminate, dorsal line. Ventrally ochreous with purplish suffusion on anterior segments and traces of the usual two small dark dots on each segment on both sides of the median line; forceps pale brownish, penes ochreous at base, darker at tips which are strongly bifid; setae dark smoky. Prolegs dark yellow-brown with a smoky tinge; four posterior legs deep yellowish with a faint dark dot or blotch at apex of femur. Wings vitreous, venation pale brown, deeper on costal half of primaries, cross-veins pale and indistinct. Length of body 10 mm.; of forewing 11 mm.

Holotype—♂, Nordegg, Alta., July 14, (J. McDunnough); No. 779 in the Canadian National Collection, Ottawa.

Paratypes—5 ♂, Popoff Is., Alaska, July 12, (Harriman Alaska Exped.); in the United States National Museum.

The Alaska specimens were recorded as *grandis* Eaton in the report on the Harriman Expedition but this is a much larger Coloradan species with different venation (genus *Drunella*). *Norda* seems to be considerably larger than either of Walker's described species from the Hudson Bay region; the characteristic ♂ genitalia (fig. 5) should render it easily recognizable.

Ephemerella tibialis n. sp.

Male. Deep purple-brown, thorax dorsally almost blackish, abdomen narrowly ringed with semitranslucent whitish on anterior margins of segments 3-8; traces of a medioventral series of dark ganglionic spots. Base of forceps ruddy, second and third joints blackish, the former rather broad and laterally compressed; penes strongly bent upwards beyond base, blackish, deeply bifid at tip; setae deep smoky. Fore femur light smoky yellow, fore tibia deep smoky, very long, fully twice the length of femur, tarsi somewhat paler than tibia; four posterior legs dull yellowish with ruddy apical band on the femora. Wings vitreous with pale grey-brown venation, the crossveins slightly tinged with the same color and more distinct than is general in the species of this genus. Length of body 7.5 mm.; of forewing 8 mm.

Holotype—♂, Banff, Alta., Sept. 19, (C. B. Garrett); No. 780 in the Canadian National Collection, Ottawa.

The species is a small fragile one, rather resembling a *Leptophlebia* superficially. The banded abdomen and long fore tibia seem characteristic.

Siphlonurus berenice McD.

syn. *Siphlonurus novangliae* McD. 1924, Occ. Pap. Bost. Soc. Nat. Hist. V, 75.

On making a slide of the genitalia of the unique male type of *berenice* I find that these are identical with those of *novangliae* McD. The figure I gave of these organs in the original description was drawn from the dried specimen and the parts were evidently distorted and partially hidden by the dried exhudations. The type of *berenice* is smaller and somewhat duller in coloration than the paratypes of *novangliae* before me, but a long series received this year from Covey Hill, Que., shows intergradations and I believe the two names represent but a single species. It might be noted that the stimuli are generally not so sharply bent in apically as is shown in my drawing of the genitalia of *novangliae* (l. c. Pl. VI, fig. 3); they are more (especially in dried specimens) as in the corresponding parts of fig. 4.

Siphlonurus barbarus n. sp.

Male. Head brown with front edge of clypeus pale and ocelli tipped with whitish; thorax brown, the pleura with the sutures marked in pale ochreous, abdomen dorsally brown with the anterior edge of each segment pale yellowish, semitranslucent; on the posterior segments traces of dark dorsal and subdorsal longitudinal dashes are visible; ventrally pale yellowish with a lateral oblong dark brown patch on each segment except the ninth which is largely dark brown; subgenital plate pale ochreous, forceps smoky brown, setae light ochreous ringed with brown. Legs pale ochreous brown, the forelegs deeper in color; tips of femora and joinings of tarsi marked with dark brown. Wings hyaline with brown venation. Length of body 10 mm.; of forewing 11 mm.

Holotype— ♂, Big Indian Valley, Catskill Mts., N. Y., June 9, 1910, (R. F. Pearsall); in the collection of the American Museum of Natural History.

Paratype— ♂, same locality and collector, June 7; No. 815 in the Canadian National Collection, Ottawa.

The species is very similar to *berenice* McD. but with the abdominal markings better defined and with distinctly different male genitalia (fig. 7).

Heptagenia kennedyi n. sp.

Male. (alcoholic). Head pale with a few slight dark dots on the clypeus; thorax light brown, the prothorax tinged with smoky posteriorly; abdomen pale hyaline with smoky tinges dorsally, tending to form faint bands across the segments on their posterior border. Legs pale; with no markings either at base of coxae or on femora. Forelegs tinged with black at apices of femur and tibia; first joint one-sixth the length of second. Wings vitreous with the veins colorless.

Female. Entirely pale ochreous, without obvious maculation. Length of body 7-8 mm.; of forewing 9 mm.

Holotype— ♂, Calistoga, Napa Co., Calif., (Kennedy); No. 817 in the Canadian National Collection, Ottawa.

Allotype— ♀, same data.

Paratypes—6 ♂, 14 ♀, same data, in the Canadian National Collection, Ottawa, and Collection Kennedy.

The material is not in the best of condition but the genitalia (fig. 2) seem distinct from those of other described species in the group.

Heptagenia flavianula n. sp.

Male. Clypeus dull gray, crossed by a black band at its base, head in the region of antennae and ocelli ochreous; thorax deep brown, a pale ochreous patch anterior to the wing roots, containing two blackish streaks, base of wings and pleural sutures marked with ochreous. Abdomen deep ruddy brown with the lateral and posterior edges of the dorsal sclerites narrowly light yellow; ventrally the brown color becomes darker on the posterior segments and the posterior edge is banded with yellow as on dorsum; forceps deep brown; setae blackish. Forelegs blackish, posterior legs golden brown, the femora with a black streak on basal half, tarsi blackish. Wings vitreous, tinged with pale amber in pterostigmatic region and with black-brown venation. Length of body 14 mm.; of forewing 15 mm.

Holotype—♂, Gunnison, Colo., June, (E. J. Oslar); No. 794 in the Canadian National Collection, Ottawa.

Paratypes—5 ♂, same data; 3 ♂, Glenwood Spgs., Colo., (Oslar).

The species is similar to *brunnea* Hagen but considerably larger, and with brighter coloring, especially on the underside of the abdomen, where the yellow annulations stand out prominently from the general deep brown color of the segments. The ♂ genitalia (fig. 3) show slight points of distinction from those of *brunnea* as figured by Dodds (Trans. Am. Ent. Soc., XLIX, Pl. VIII, fig. 13).

Ecdyonurus lyriformis n. sp.

Male. Head brown with pale clypeus and black shading around the ocelli; thorax brown, shaded slightly with ochreous on rear of mesonotum and with lateral edge of same anterior to wing bases marked with pale yellow; pale shading on pleura at base of wings. Abdomen dorsally with segments 2-7 pale semi-translucent whitish with the posterior edge of each segment deep brown; traces of a geminate brown dorsal line; midway between this centrodorsal line and the spiracular flange the brown posterior band juts forward triangularly to a point midway between the anterior and posterior margins; three posterior segments almost entirely light brown, opaque. Ventrally the abdomen is pale whitish with the posterior segments tinged with ochreous brown and with a centrodorsal row of small brown spots. Setae dull brown, forceps similarly colored. Fore femora and tibiae light brown, the former twice banded with deeper brown (these bands rather indistinct) and with dark apex, the latter with base and apex narrowly black-brown, fore tarsi pale grayish, the first joint about one half the length of the second; four posterior femora similar to fore femur, tibiae paler. Wings hyaline with fine light brown venation, the cross-veins being almost colorless and very indistinct in the costal region except at apex of wing where they are divided by a fine line running just below costa, forming a series of small costal and much larger subcostal cells. Length of body 11.5 mm.; of forewing 12 mm.

Holotype—♂, Banff, Alta., July 30, (C. B. D. Garrett); No. 819 in the Canadian National Collection, Ottawa.

Paratypes—2 ♂, same data.

The subimagos, of which there are two before me, show unicolorous smoky wings. The generic position of the species is a little doubtful; the comparative lengths of the fore tarsi point to *Ecdyonurus* but the genitalia (fig. 1) are quite different from the usual characteristic form of this genus, the penes being roughly lyre-shaped; the subdivision of the costal crossveins in the pterostigmatic region is also not typical of *Ecdyonurus*.

EXPLANATION OF PLATE 5.

Fig. 1 Male genitalia of *Ecdyonurus lyriformis* McD.
" 2 " " " *Heptagenia kennedyi* McD.
" 3 " " " " *flavianula* McD.
" 4 " " " *Leptophlebia associata* McD.
" 5 " " " *Ephemerella norda* McD.
" 6 " " " " *infrequens* McD.
" 7 " " " *Siphlonurus barbarus* McD.

THE GENUS ARHAPHE IN THE UNITED STATES (HEMIPTERA-PYRRHOCORIDAE)

BY H. G. BARBER,
Roselle, N. J.

The discovery of a new species of *Arhaphe* from Kansas further establishes and emphasizes the generic characters first fixed by Herrich-Schaeffer for *A. carolina* in 1853. In addition to the characters given by that author there should be added; the body and legs rather profusely long setose; anterior lobe of the pronotum and the ventral parts, in the main, densely whitish tomentose; anterior femora unarmed. Distant in Biol. Centr. Am., Heteropt. I, 227, 1883 established the genus *Japetus* with his *sphaeroides* from Guatemala as type. In the Journ. N. Y. Ent. Soc. XIX, 28. 1911, I described *Arhaphe mimetica* from Arizona and placed *Japetus* Dist. as synonymous with *Arhaphe* H. S., which course was followed by Van Duzee in his Catalogue. There is now little doubt in my mind that Distant's genus will have to be retained and my *mimetica* included, as it presents several good differential characters, as follows : head more globose, as long as but considerably wider than the pronotum; membrane less abbreviated; body and legs without profuse coating of long setae, almost nude; posterior lobe of pronotum not at all or very sparsely tomentose; anterior femora armed with a single small tooth near apex; rostrum short.

Arhaphe breviata n. sp.

Colored and marked as in *carolina* and *cicindeloides*, and likewise profusely long setose. Head shining black; anterior lobe of pronotum, sternum and venter except for three lateral areas and the last genital segment of the male and the last two of the female, the fifth dorsal segment and the connexivum of 3rd, 4th, and 5th segments densely greyish tomentose; posterior lobe of pronotum, scutellum, clavus, corium and abbreviated membrane dull, velvety black; nearly the anterior and the apical half of the corium white; antennae, rostrum, legs except tarsi, abdomen except for the fore mentioned parts, venter with the three lateral areas, the first of which is the largest and the genital segments shining black; tarsi castaneous.

Head very convex above and below, shorter than pronotum, one-third wider than long, width across eyes equal to diameter of posterior lobe of pronotum, impunctate but finely rugulose, with erect, long black setae intermixed with gray anteriorly, with two pit-like depressions on the vertex, each over twice as far from the eyes as they are remote from each other; eyes large, globose, set a little closer to posterior than to anterior margin of head, rounded postocular region more abruptly contracted posteriorly than in the two related species. Antennae relatively short, a little shorter than the head and pronotum taken together, rather densely long pilose and the three basal segments with a dense coating of appressed gray hairs, basal segment lightly curved and gradually widened toward apex, wider there than the diameter of the second or third segments, about equal to diameter of the fourth, much shorter than the head, second segment a little longer than basal, third segment shortest of all, about one third shorter than second, fourth segment a little longer than the second. Rostrum reaching back to middle of intermediate coxae, enlarged basal segment subequal in length to basal segment

of antenna, reaching back to a point just behind line of posterior margins of eyes, first and second segments subequal, the latter somewhat shorter than the two apical taken together, fourth a little over half as long as third. Pronotum impunctate, one fourth wider than long with the anterior lobe not twice as long as posterior lobe, and very little narrower; transverse sulcus more shallow and the anterior rounded margin more abruptly contracted back of eyes than in *cicindeloides*; without evidence of a collar. Hemielytra with the clavus sparingly punctate; corium sparingly somewhat obsoletely punctate before and behind the transverse fascia and furnished with a single row of large fuscous punctures parallel to the claval suture; the apical white spot more transverse than in *cicindeloides*. Membrane black, very narrow, represented by a narrow border along the inner apical half of posterior margin of corium, reaching posterior margin of third abdominal segment. Legs relatively shorter than in *cicindeloides*, posterior femora not reaching back as far as the apex of abdomen; femora and tibia densely long setose, interspersed with shorter grayish hairs; anterior femora rather strongly incrassate, unarmed; tarsi rufo-castaneous with segments paler at base, basal segment of posterior a little longer than the two apical ones taken together.

Length : male 7.30 mm. ; female 8.25 mm.

Type : male, Geary Co., Kansas (My Coll. from Wm. J. Gerhard).

Allotype : taken with male (Coll. Field Mus.).

Paratypes : 16 males and 15 females from Riley, Kiowa, Logan and Trego Counties, Kansas (Coll. Kansas Agr. College).

This species, most closely related to *cicindeloides*, may readily be distinguished from that species by its shorter and more abruptly declivous head, shorter antennae and legs, absence of collar and by the row of fuscous punctures along the claval suture, etc.

KEY TO SPECIES

1. Head subequally long but much wider than pronotum, finely rugulose. Nonsetose or very nearly so. Anterior femora with a small subapical tooth. (Type : *sphaeroides* Distant) ..... *Japetus* Distant.
   Head shorter but subequal in width to the pronotum, punctate or finely rugulose. Anterior lobe of pronotum and beneath densely whitish tomentose. Anterior femora unarmed. (Type: *carolina* H. S.) ..... *Arhaphe* H. S. 2.
2. Head and pronotum distinctly, coarsely punctate. First segment of rostrum and of antenna subequal. Membrane more developed and white at base. . . .. *carolina* H. S.
   Head and pronotum impunctate, the former finely rugulose ..... 3.
3. First segment of antenna plainly longer than first of rostrum. Collar evident. Corium without a row of fuscous punctures along claval suture. Posterior femora extending nearly to apex of abdomen. ..... *cicindeloides* Walk.
   First segment of antenna subequal to first of rostrum. Collar not evident. Corium with a row of fuscous punctures along the claval suture. Posterior femora not extending beyond apex of fourth abdominal segment *breviata* n. sp.

FOOT NOTE for page 224.

*—Specimens of *Chitonophora aurivillii* Bgstn., from Lappland, just received from Dr. Bengtsson, show great similarity to *norda*. It is quite probable that the two are identical.

Mailed October 1st, 1924.